NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594

February 2, 2000

MATERIALS LABORATORY FACTUAL REPORT Report No. 00-030

A. ACCIDENT

Place	:	Nantucket Island, Massachusetts
Date	:	October 31, 1999
Vehicle	:	Boeing 767-366ER, SU-GAP
NTSB No.	:	DCA00-M-A006
Investigator	:	Jim Hookey, AS40

B. COMPONENTS EXAMINED

Strand of metal collected from the No. 2 engine scavenge pump magnetic chip detector.

C. DETAILS OF THE EXAMINATION

A particle, identified in the component examined list as a “strand of metal collected from the No. 2 engine scavenge pump magnetic chip detector” was submitted to the materials laboratory attached to the sticky side of a piece of scotch tape. The chemical composition of this particle and other particles collected from the chip detector was determined using X-ray Energy Dispersive Spectroscopy (EDS). To eliminate electrical charges, the side of the tape containing collected particles was sputtered with a thin layer of gold-palladium coating. The dimensions of particles were measured in the scanning electron microscope (SEM) equipped with a linear measuring unit.

An SEM view of the “metal strand” is shown in figure 1. This particle was about 0.03 inch (0.75 mm) long and ranged in diameter from 0.0003 in. (0.0085 mm) to 0.0008 in. (0.0210 mm). The EDS analysis performed on the surfaces of this particle generated a spectrum containing iron (Fe) and oxygen (O) as major peaks, consistent with the chemical composition of iron oxide, see figure 2.

The vast majority of particles in the sample collected from the chip detector were crystalline looking when viewed with a binocular microscope. An SEM view of these particles is shown in figure 3 and then at a higher magnification in figure 4. The EDS analysis of these particles generated spectra containing silicon (Si) and oxygen (O) as major peaks, typical of chemical composition of sand, see figure 5. Most of the sand

particles were covered with powdery deposits that were identified as iron oxides by the EDS analysis. The iron oxides are indicated by unlabeled arrows in figure 4, and the typical spectrum generated from these deposits is shown in figure 6.

Other particles in the submitted sample could be divided into two general groups:

Fiber looking fragments. An SEM view of a typical fiber-looking particle is shown in figure 7. The EDS analysis of these fragments generated spectra containing carbon and oxygen as major peaks, consistent with the chemical composition of an organic material, see figure 8.

Powder looking particles. An SEM view of three particles representative of this group is shown in figure 9. An average diameter of these particles was 0.0006 in. (0.015 mm); the EDS spectrum contained aluminum (Al) as a major peak. A typical spectrum generated from the surface of one of these particles is shown in figure 10.

Jean Bernstein
Senior Metallurgist

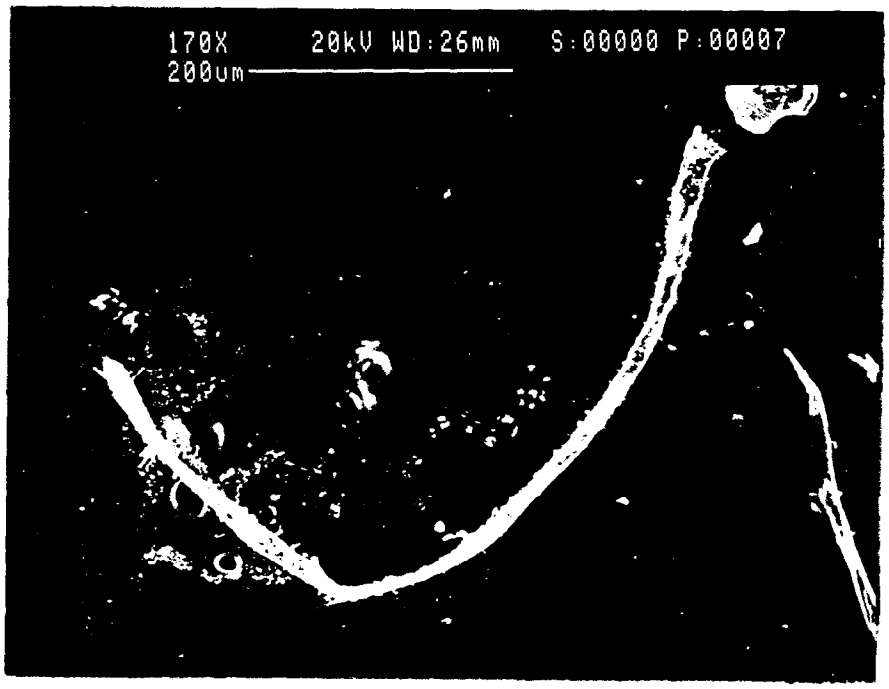

Figure 1. An SEM view of the "metal strand". (170X).

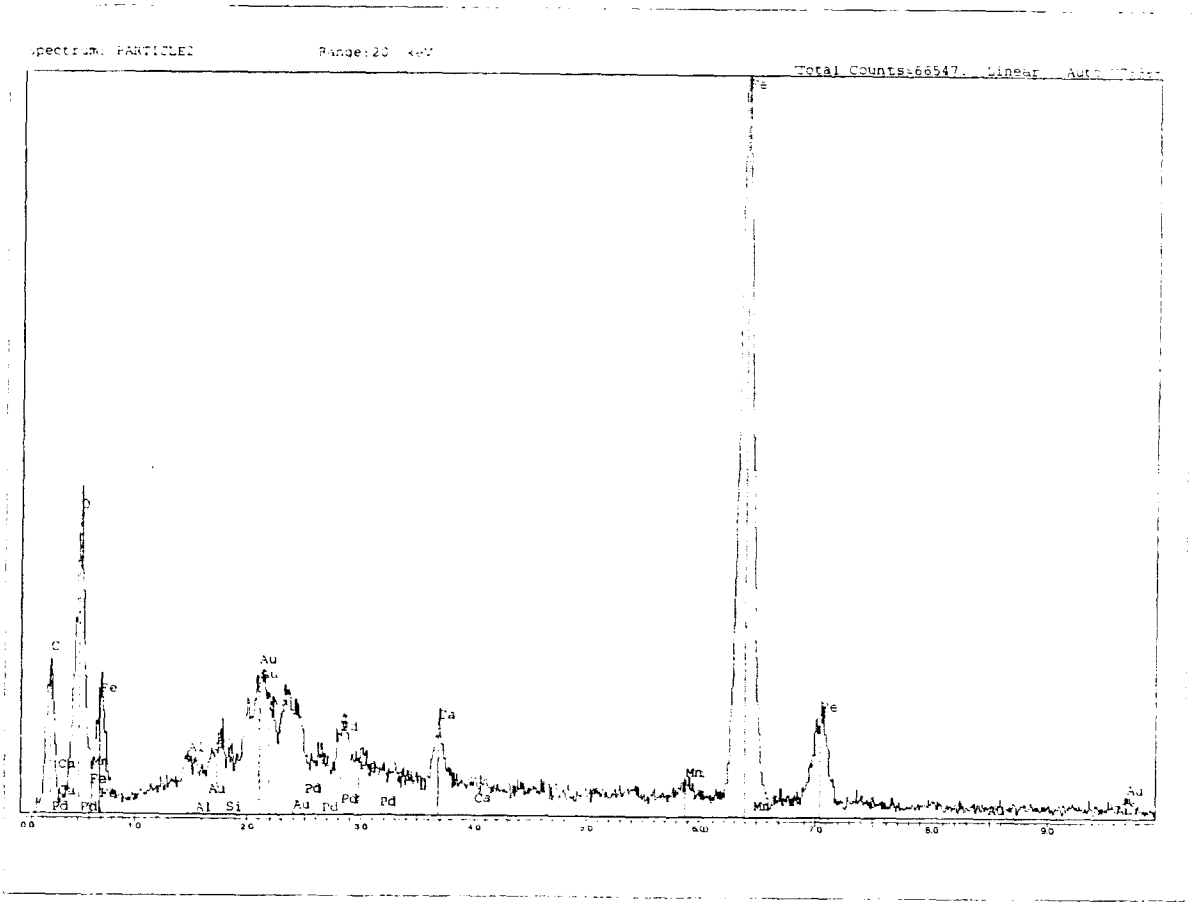

Figure 2. EDS spectrum generated from the surface of the particle shown in figure 1.

Appendix 3

Figure 3. A low magnification SEM view of the majority of particles in the submitted sample. (108X).

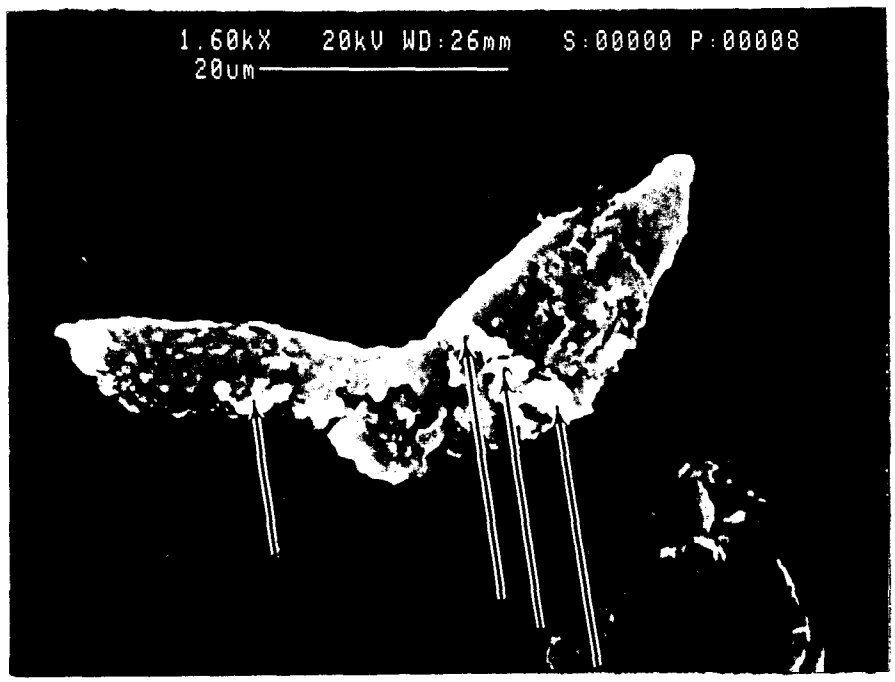

Figure 4. A higher magnification view of a typical particle in the group shown in figure 3. Unlabeled arrows indicate some of the iron oxide deposits. (1,600X).

APPENDIX 3

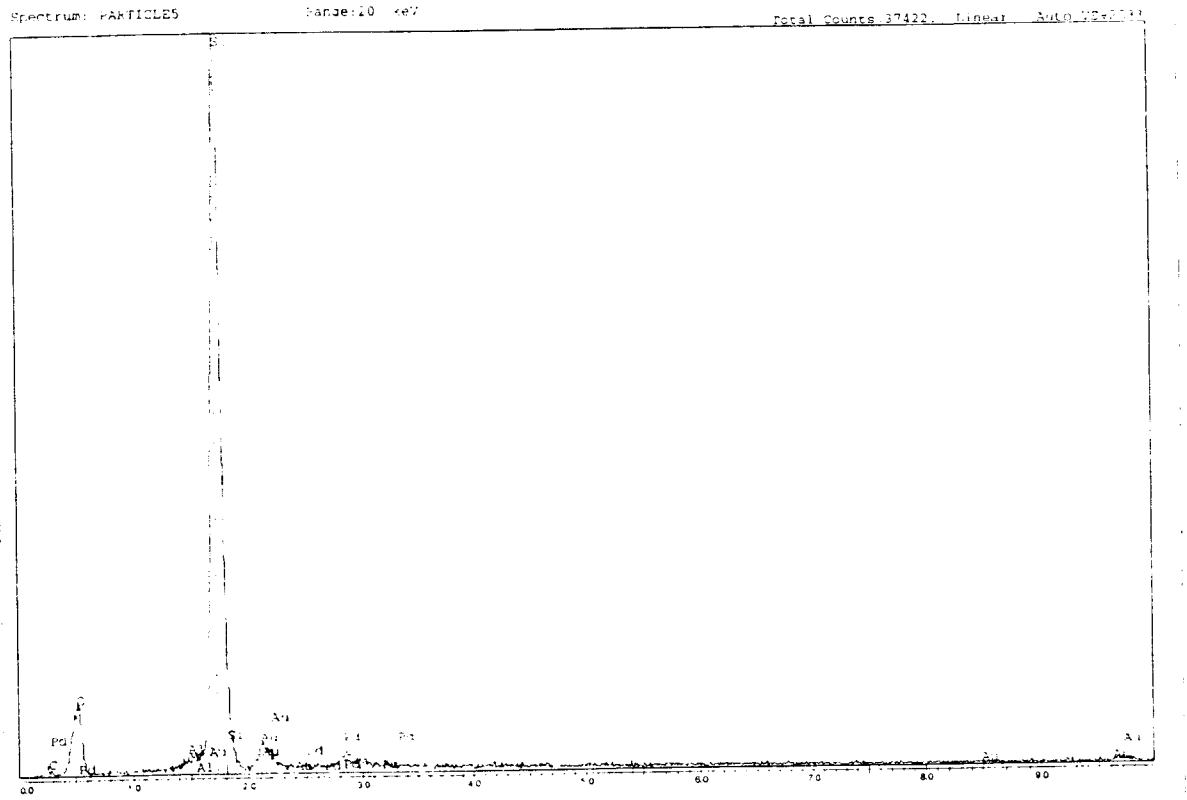

Figure 5. EDS spectrum generated from particles shown in figure 3 in the areas not covered by deposits.

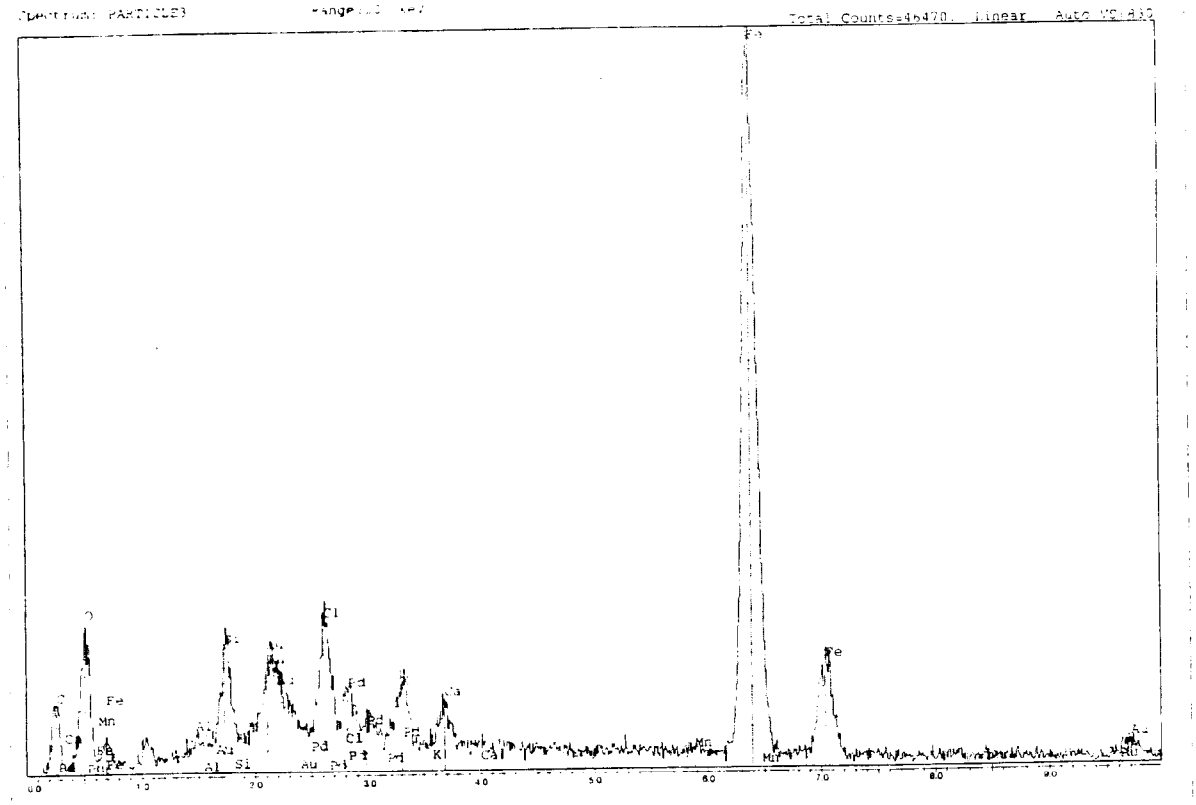

Figure 6. EDS spectrum generated from areas denoted by unlabeled arrows in figure 4.

APPENDIX 3

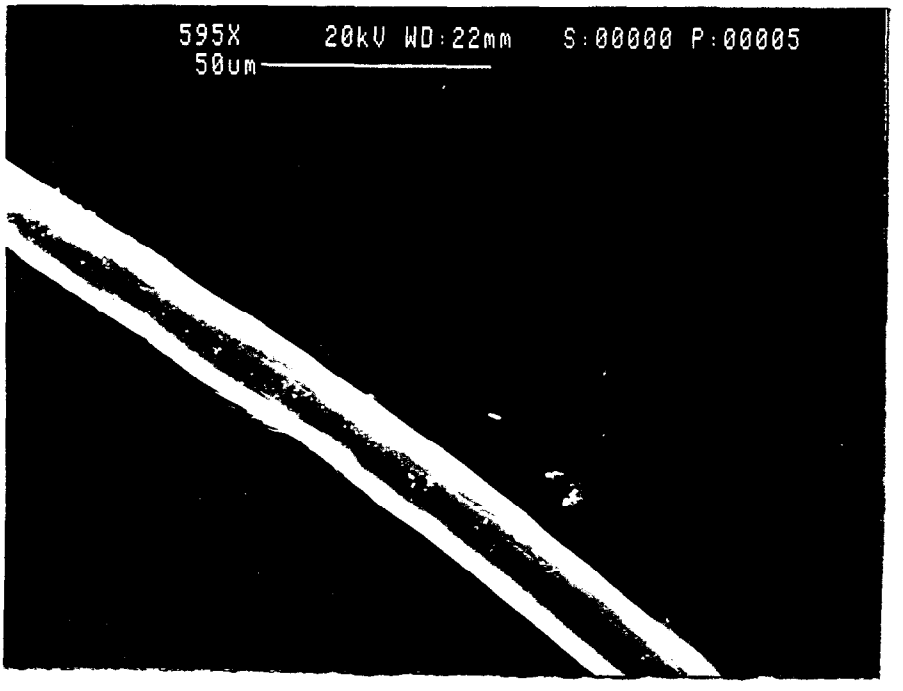

Figure 7. An SEM view of a typical fiber looking particle. (595X).

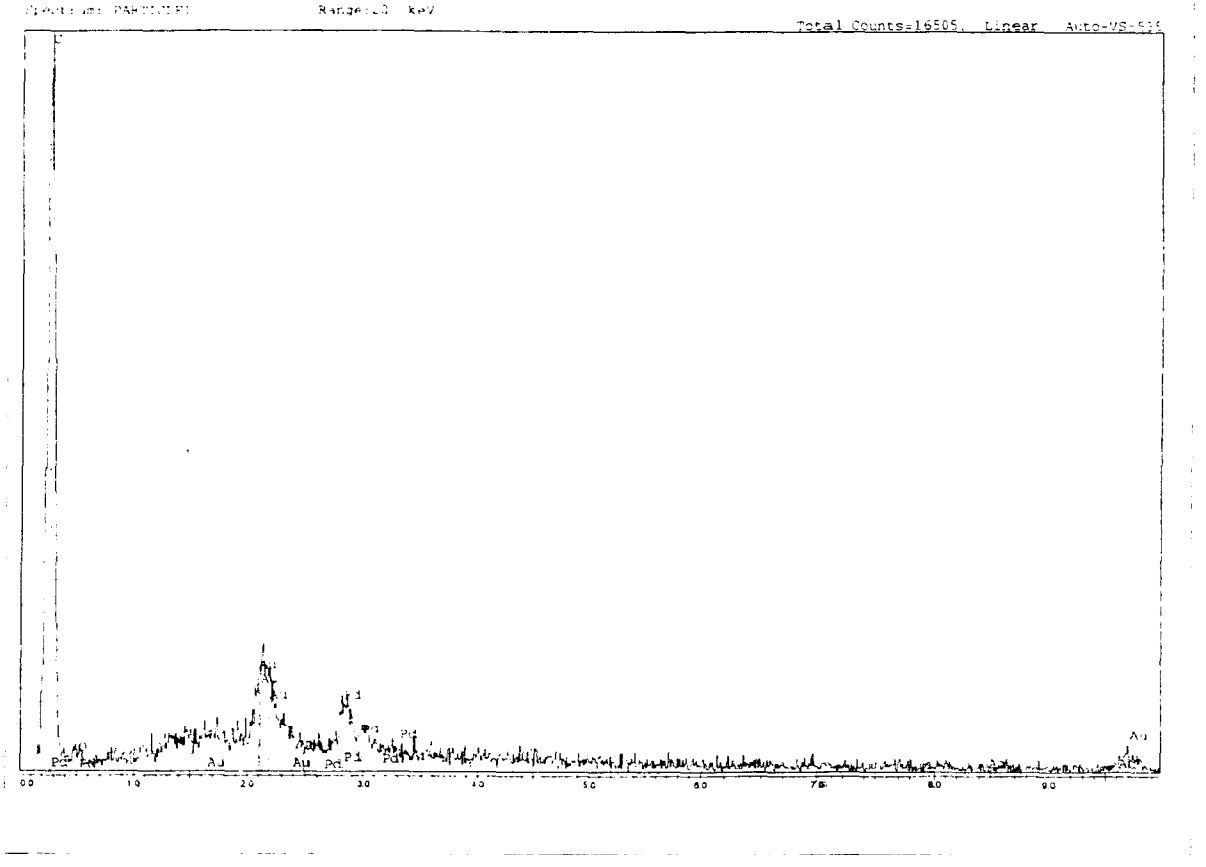

Figure 7. EDS spectrum generated from a typical fiber looking particle.

APPENDIX 3

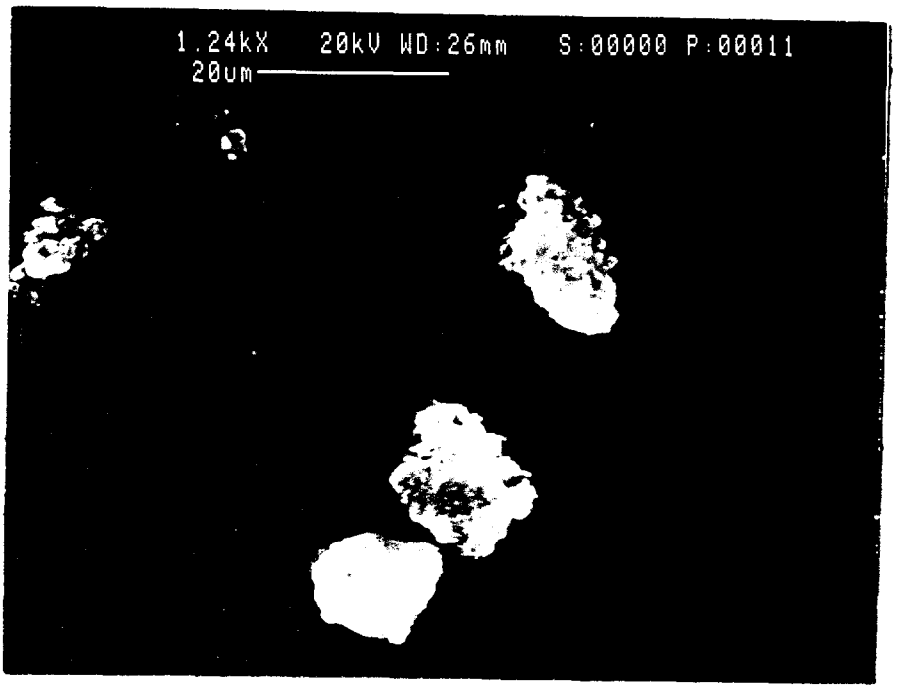

Figure 9. SEM view of typical powder looking particles. (1,240X).

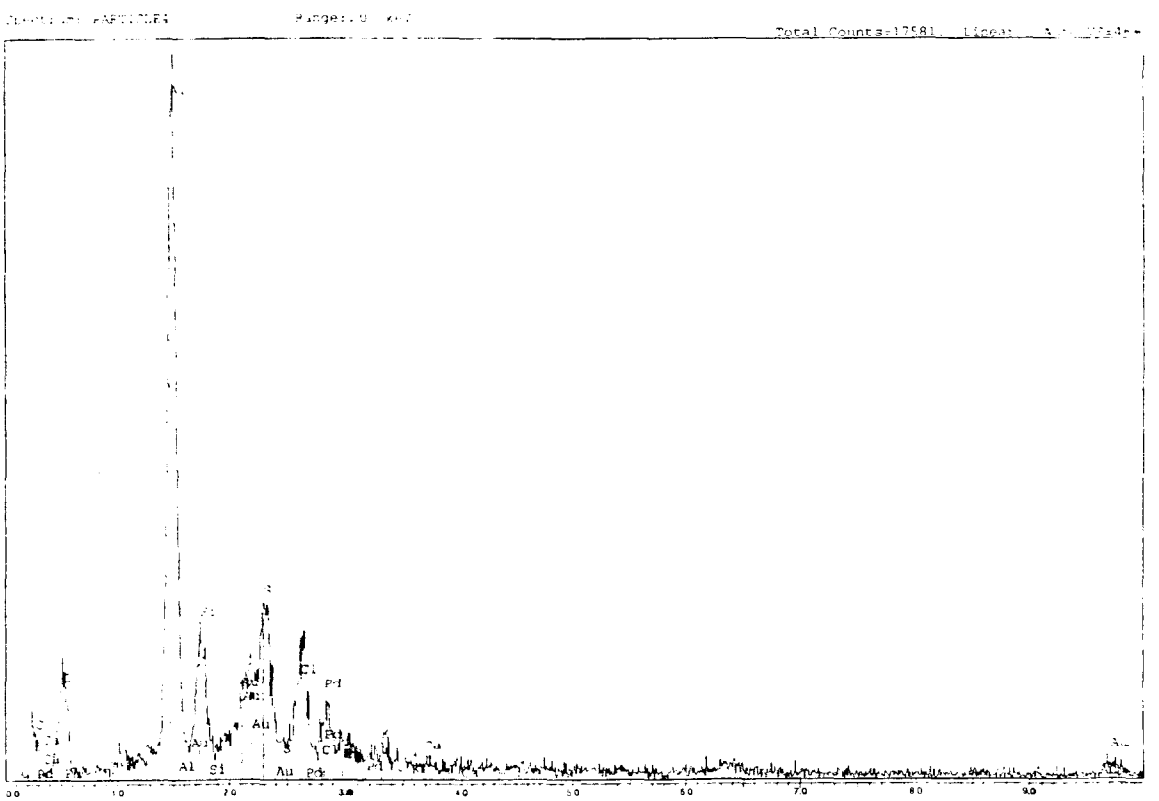

Figure 10. EDS spectrum generated from a typical powder looking particle.

APPENDIX 3